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ABSTRACT

The PLATO Elementary Reading Curriculum (PERC) requires the use of two interactive PLATO terminals in each classroom, and each unit uses a random access audio device which is connected directly to the terminal. Messages from the command unit can direct the audio unit to deliver verbal instructions to the student user at the terminal. The PERC project has developed four simple guidelines for using audio in lessons: (1) keep messages as short as possible; (2) make cues easily identifiable: (3) allow students to interrupt the audio; and (4) provide minimal context to aid understanding. These guidelines have been found effective with six-year-olds. (EMH)

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USING AUDIO WITH CAI LESSONS

Experiences of the PLATO Elementary Reading Project

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For the past five years, the PLATO Elementary Reading Curriculum (PERC) Project has been developing activities primarily for use in first grade classrooms. In the 1975-1976 school year, twenty-five classrooms with over 750 students used PERC materials.

The typical classroom has two PLATO terminals in the classroom; each terminal is equipped with a touch panel, slide projector, and an audio unit. Students normally spend about fifteen minutes at the terminal; and they manipulate all of the hardware themselves; that is, they insert a microfiche into the slide projector, and they change records on the audio unit.

Random Access Audio

PERC uses a random access audio unit which is connected directly to the terminal. The command to play a message is sent from the computer, through the terminal, to the audio unit; the computer tells the audio where to start playing and how long that message will last. The computer retains control so that other processing can continue, such as displaying graphics on the terminal which coincide with what the audio is saying.

The audio record holds up to twenty-two minutes of recorded information. A single message can be as short as one-third second, or as long as forty-two seconds. Any message on the record can be accessed within one-half second after receiving the command from the computer. The records are made from large sheets of magnetic recording tape (the type used in tape recorders). Therefore, the audio unit can both play messages and record directly on to the record. Records can also be erased and used over and over again.

Using an audio unit that allows random access has been very important in developing PERC lessons. The alternative would have been to use serial audio (such as a cassette tape recorder) which would have required that lessons be organized so that all messages would be played in a predetermined order.

The most obvious advantage is that PERC has been able to produce some unique activities which allow each student to explore the activity in his own way; for example, one lesson puts a list of sight words on the screen and allows the student to hear any word by touching it.

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Many PERC lessons are in such a stable condition now that they could almost be used with serial audio; all of the directions and items in the exercise are in an optimal sequence. But because of the random access capability PERC has been able to implement some powerful pedagogical strategies which would not have been possible with serial audio. For example, when a student misses a drill item, he not only is given immediate correction, but that same item will reappear in the drill as the third and fifth items after the error. Such strategies have been very successful with students. Thus, pedagogical strategies are not overruled by technological limitations.

An added bonus of random access audio has been that lessons have been easier to develop. When a lesson had to have an audio message changed or added, all that had to be done was to find an open area on the record and add the new message; with serial audio such changes would have been much more tedious.

Guidelines for Using Audio in Lessons

The PERC Project has developed four simple guidelines for using audio in lessons. But as obvious as these guidelines may appear, PERC has experimented with lessons in the past which follow completely opposite conventions. These guidelines have emerged as the ones that work best with our six-year-old population.

Guideline 1: Keep it short. The paradigmatic audio message is, "Do it" and PERC tries to translate all direction giving messages into something only slightly less cryptic. Elaborate explanations and rationales are eliminated; the audio must focus the student on the task and let him interact with the lesson as quickly as possible.

That guideline comes from years of watching children become distracted while a long audio message is recited to them. They "tune out" in the middle of the message and often miss the cue telling them what to do; then they either fail to respond or respond inappropriately.

Obviously not all children follow that pattern. Conventional children will put up with anything (perhaps these are the college-bound students?). But a large number of six-year-olds view the terminal as a place where they can express themselves; and they do not have the patience to listen to the terminal express itself. PERC has had more success in aiming lessons at these expressive students than in trying to make the expressive students conform to conventional patterns.

It may seem as though PERC is shirking its duty to teach the expressive students to pay attention. Nevertheless PERC teachers report that one of the fringe benefits of using PERC lessons is that students develop better listening skills.

How long is a short audio message? The average PERC lesson runs about 2:50 minutes of which forty-seven seconds is audio. The average lesson has seventeen audio messages; each message lasts an average of 2.8 seconds. That means the student gets about three seconds of audio

every ten seconds (based on data from 113,312 uses of PERC lessons in 1975-1976).

Eight of the seventeen messages are short messages less than 2.4 seconds; they are the drill items, such as single words, letters, or sounds. If the short messages are excluded so that only messages greater than 2.4 seconds are counted, the average audio message is still a brief 3.94 seconds.

Not only are audio messages kept short, but audio is usually faded in each lesson. There is usually a great deal of audio at the beginning of a lesson while the activity is being set up; but audio is quickly withdrawn once the student demonstrates that he understands the nature of the interaction. Audio feedback is severely limited with an emphasis being put on visual feedback. For example, the first few times a student makes a correct response, the audio might say, "good," and there would be an appropriate screen display; but then the audio is withdrawn and the student is reinforced by the visual display only.

Audio is limited because it intrudes on the pace of an interactive lesson. Students want to make the terminal "work," not listen to long explanations. A good lesson strives to make students active learners rather than passive listeners.

Guideline 2: Give the cue at the end of the message. For example, if the audio says, "Tap the word up to make the elevator go up," the student is likely to start responding as soon as he hears, "Tap the word up...." A better audio message would put the cue at the very end: "Make the elevator go up. Tap the word up."

A corollary to this rule is that complicated sentence structures should be avoided so that the cue is easily identifiable. Conditionals, for example, always cause problems; in a message like, "If you want the elevator to go up, then tap the word up," the if-then construction can complicate things sufficiently so that the student fails to comprehend what he is expected to do.

Guideline 3: The student must always be able to interrupt an audio message with a correct response. At one time PERC lessons would not accept any type of response until the directions on the audio were completed. But students often understand the nature of the task before the audio message is completely finished; and because they respond by simply touching the screen, students can enter several responses during the last second or two of an audio message. Students were observed to enter the correct response, get no feedback because the audio message was just finishing, and switch to an incorrect response just as the audio message ended.

The same problem occurs on remedial messages after an incorrect response. The student often recognizes the tone of the message and moves immediately to his second choice for an answer. While it may seem pedagogically desirable to explain to the student why he was wrong, in practice it does not work. People make explanations; machines do not. Machines are simply expected to perform in specified ways; so when the student enters the

correct response, he expects that the machine will respond appropriately. If a student makes a correct response while an audio message is in progress, the audio message is immediately stopped, and the positive feedback is begun. This avoids the paradox of having the audio continue to tell the student to do something that he just did.

While an audio message is in progress, incorrect responses are ignored; the audio continues uninterrupted. This is really done out of necessity. If an incorrect answer was accepted before the audio had given the cue, the lesson would have to contain special remediation which would explain the task that was supposed to have been explained in the interrupted message; and that remedial message itself might have to be subject to interruption. In PERC's very early years, a few lessons were written that way. Some students quickly learned the joys of making the audio unit go crazy by repeating incorrect answers every second or two; this caused the audio to restart the same message over and over and over again.

The strategy of ignoring incorrect responses while audio is in progress is effective. It takes advantage of the students' strong desire to make the terminal "work." Receiving negative feedback is perceived by students as making the terminal work; and it is sufficiently reinforcing that students will persist in making the wrong response. But receiving no feedback at all discourages students from responding unless they are fairly certain that it is going to have an effect.

There is a glaring loophole in that strategy, however. If the student makes all possible responses while the audio is in progress, the incorrect responses will be ignored and the correct response will be rewarded. In fact, that happens very seldom. In the few cases where it did happen, the lesson was changed to stop it. One change that worked was to not display the answers until the audio was completed. Another method was to stop the audio, erase the screen, and restart the frame after telling the student that he had to start over because he had answered too soon; the success of this latter method has not been evaluated yet.

Guideline 4: Audio should be embedded in a context. Messages like, "Touch the word boy," were effective with some students but many students seemed to have difficulty comprehending what the audio said; they lacked the proper psychological set to handle the directions. Students sometimes verbalized what they thought they heard; their errors could be loosely grouped into four categories: 1) homonyms (boy-toy); 2) words conceptually linked (boy-runs); 3) words prompted by the sequencing in the exercise (if word one was "cat," and word two was "frog," the student might hear "dog" both because it sounds like "frog" and because of its relationship to "cat"); and 4) other answers on the screen (note that the students had to read the other answers).

There are two ways to provide context for an audio message: add more audio, or add a visual display. Sometimes the only thing that can be done is to add more audio despite the fact that this violates guideline 1. But students are more likely to tap the word "up" if the audio cue is prefaced with a short statement like, "Make the elevator go up."

A better way of providing context is to add a visual display; if the audio says, "Tap the word boy," a picture of a boy can be shown on the screen.

Data was gathered during the 1975-1976 school year which tend to support the importance of a visual context. Records of errors were kept for forty auditory discrimination exercises; all forty exercises operate in the identical way except for the fantasy used for motivation; in a -t- exercise the student adds men to a tug-of-war team; in an -h- exercise, he adds horseshoes; etc. The task is for the student to decide whether or not a word presented by the audio begins with a specified sound; for example, does "telephone" start with /t/. This would seem to be a listening task; the student should not even have to understand the word in order to decide whether he hears a /t/ or not.

Twenty-five of the forty exercises presented the word via audio only; for the other fifteen exercises a picture was displayed on the screen while the audio said the word. After 44,268 trials, words given by audio alone had an error rate of 21%; words given by audio accompanied by a picture had an error rate of 12%.

Ninety-three of the words were used in both ways; they were used with pictures in some exercises, and without pictures in others. This was done primarily because many exercises were on the same record and they shared the same pool of words; hence the students heard the same recording of the word both with and without pictures. Approximately the same error rates held: for 17,572 trials, words without pictures had a 22% error rate; words with pictures had only a 12% rate.

Future Plans with Audio

There are two areas in which PERC would like to experiment with audio. First, students could record their voices on the record; this is essentially a language lab approach. The student could compare his voice to a pre-recorded model in order to decide when he is close enough; and a teacher could spot check her students' recordings to make sure they are performing adequately. This would by no means be a substitute for the teacher listening to the student recite in the classroom; but it may be a way of giving students added practice in producing speech without putting a great deal of overhead on the teacher.

The second area would involve a much more radical change. Currently audio is delivered automatically throughout a lesson but PERC has now developed a few lessons in which the student has to request the audio either by touching someplace on the screen or by pressing a key. Thus the learner gains control over the flow of information that is directed at him. He can be somewhat selective about what information he wisnes to receive; for example, students who have seen a few of those forty auditory discrimination exercises do not usually need even the minimal directions given at the beginning of each exercise; with "learner-controlled" audio they could skip past the directions.

The few lessons that have been developed with "learner-controlled" audio have been in a very narrow range. Various types of lessons will

have to be developed before the usefulness of this strategy can be evaluated.

Summary

PERC follows the principle that the best audio is the least audio. That principle is put into practice by, 1) keeping messages as short as possible; 2) making cues easily identifiable; 3) allowing students to interrupt audio; and 4) providing minimal context to aid understanding. And it would be extended even further if learner-controlled audio were implemented.

The guidelines described have been found to be effective with six-year-olds. But they are probably somewhat valid for all age groups although older students may put up with slightly longer audio messages, and may require fewer prompts.

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